SCIENCE

New Series
Vol. LIV, No. 1402

Friday, November 11, 1921

Single Copies, 15 Cts.
Annual Subscription, $6.00

SCIENCE

FRIDAY, NOVEMBER 11, 1921.

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE MESSAGE OF SCIENCE.[1]

IT is just forty years ago, at the York Meeting in 1881, that a committee was appointed "to arrange for a conference of delegates from scientific societies to be held at the annual meetings of the British Association, with a view to promote the interests of the societies represented by inducing them to undertake definite systematic work on a uniform plan." The association had been in existence for fifty years before it thus became a bond of union between local scientific societies in order to secure united action with regard to common interests. Throughout the whole period of ninety years it has been concerned with the advancement and diffusion of natural knowledge and its applications. The addresses and papers read before the various sections have dealt with new observations and developments of scientific interest or practical value; and, as in scientific and technical societies generally, questions of professional status and emolument have rarely been discussed. The port of science—whether pure or applied—is free, and a modest yawl can find a berth in it as readily as a splendid merchantman, provided that it has a cargo to discharge. Neither the turmoil of war nor the welter of social unrest has prevented explorers of uncharted seas from crossing the bar and bringing their argosies to the quayside, where fruits and seeds, rich ores and precious stones have been piled in profusion for the creation of wealth, the comforts of life, or the purpose of death, according as they are selected and used.

All that these pioneers of science have asked for is for vessels to be chartered to enable them to make voyages of discovery to

[1] Address by Sir Richard Gregory, president of the Conference of Delegates of Corresponding Societies, given at the Edinburgh meeting of the British Association for the Advancement of Science.

unknown lands. Many have been private adventurers, and few have shared in the riches they have brought into port. Corporations and governments are now eager to provide ships which will bring them profitable freights, and to pay bounties to the crews, but this service is dominated by the commercial spirit which expects immediate returns for investments, and mariners who enter it are no longer free to sail in any direction they please or to enter whatever creek attracts them. The purpose is to secure something of direct profit or use, and not that of discovery alone, by which the greatest advances of science have hitherto been achieved.

When science permits itself to be controlled by the spirit of profitable application it becomes merely the galley-slave of short-sighted commerce. Almost all the investigations upon which modern industry has been built would have been put aside at the outset if the standard of immediate practical value had been applied to them. To the man of science discoveries signify extensions of the field of work, and he usually leaves their exploitation to prospectors who follow him. His motives are intellectual advancement, and not the production of something from which financial gain may be secured. For generations he has worked in faith purely for the love of knowledge, and has enriched mankind with the fruits of his labors; but this altruistic attribute is undergoing a change. Scientific workers are beginning to ask what the community owes to them, and what use has been made of the talents entrusted to it. They have created stores of wealth beyond the dreams of avarice, and of power unlimited, and these resources have been used to convert beautiful countrysides into grimy centers of industrialism, and to construct weapons of death of such diabolical character that civilized man ought to hang his head in shame at their use.

Mankind has, indeed, proved itself unworthy of the gifts which science has placed at its disposal, with the result that squalid surroundings and squandered life are the characteristics of modern Western civilization, instead of social conditions and ethical ideals superior to those of any other epoch. Responsibility for this does not lie with scientific discoverers, but with statesmen and democracy. Like the gifts of God, those of science can be made either a blessing or a curse, to glorify the human race or to destroy it; and upon civilized man himself rests the decision as to the course to follow. With science as an ally, and the citadels of ignorance and self as the objective, he can transform the world, but if he neglects the guidance which knowledge can give, and prefers to be led by the phrases of rhetoricians, this planet will become a place of dust and ashes.

Unsatisfactory social conditions are not a necessary consequence of the advance of science, but of incapacity to use it rightly. Whatever may be said of captains of industry or princes of commerce, scientific men themselves can not be accused of amassing riches at the expense of labor, or of having neglected to put into force the laws of healthy social life. Power—financial and political—has been in the hands of people who know nothing of science, not even that of man himself, and it is they who should be arraigned at the bar of public justice for their failure to use for the welfare of all the scientific knowledge offered to all. Science should dissociate itself entirely from those who have thus abused its favors, and not permit the public to believe it is the emblem of all that is gross and material and destructive in modern civilization. There was a time when intelligent working men idealized science; now they mostly regard it with distrust or are unmoved by its aims, believing it to be part of a soul-destroying economic system. The obligation is upon men of science to restore the former feeling by removing their academic robes and entering into social movements as citizens whose motives are above suspicion and whose knowledge is at the service of the community for the promotion of the greatest good. The public mind has yet to understand that science is the pituitary body of the social organism, and without

it there can be no healthy growth in modern life, mentally or physically.

This Conference of Delegates provides the most appropriate platform of all those offered by the British Association from which a message of exhortation may be given. There are now 130 Corresponding Societies of the Association, with a total membership of about 52,000, and their representatives should every year go back not only strong with zeal for new knowledge, but also as ministers filled with the sense of duty to inspire others to trust in it. In mechanics work is not considered to be done until the point of application of the force is moved; and knowledge, like energy, is of no practical value unless it is dynamic. The scientific society which shuts itself up in a house where a favored few can contemplate its intellectual riches is no better than a group of misers in its relations to the community around it. The time has come for a crusade which will plant the flag of scientific truth in a bold position in every province of the modern world. If you believe in the cause of disciplined reason you will respond to the call and help to lift civilized man out of the morass in which he is now struggling, and set him on sound ground with his face toward the light.

It is not by discoveries alone, and the records of them in volumes rarely consulted, that science is advanced, but by the diffusion of knowledge and the direction of men's minds and actions through it. In these democratic days no one accepts as a working social ideal Aristotle's view of a small and highly cultivated aristocracy pursuing the arts and sciences in secluded groves and maintained by manual workers excluded from citizenship. Artisans to-day have quite as much leisure as members of professional classes, and science can assist in encouraging the worthy employment of it. This end can be attained by cooperative action between local scientific societies and representative organizations of labor. There should be close association and a common fellowship, and no suggestion of superior philosophers descending from the clouds to dispense gifts to plebeian assemblies. Above all, it should be remembered that a cause must have a soul as well as a body. The function of a mission-hall is different from that of a cinema-house or other place of entertainment, and manifestations of the spirit of science are more uplifting than the most instructive descriptive lectures.

Science needs champions and advocates, in addition to actual makers of new knowledge and exponents of it. There are now more workers in scientific fields than at any other time, yet relatively less is done to create enthusiasm for their labor and regard for its results than was accomplished fifty years ago. Every social or religious movement passes through like stages, from that of fervent belief to formal ritual. In science specialization is essential for progress, but the price which has to be paid for it is loss of contact with the general body of knowledge. Concentration upon any particular subject tends to make people indifferent to the aims and work of others; for, while high magnifying powers enable minute details to be discerned, the field of vision is correspondingly narrowed, and the relation of the structure as a whole to pulsating life around it is unperceived.

As successful research is now necessarily limited for the most part to complex ideas and intricate details requiring special knowledge to comprehend them, very special aptitude is required to present it in such a way as will awaken the interest of people familiar only with the vocabulary of everyday life. In the scientific world the way to distinction is discovery, and not exposition, and rarely are the two faculties combined. Most investigators are so closely absorbed in their researches that they are indifferent as to whether people in general know anything of the results or not. In the strict sense of the word, science can never be popular, and its pure pursuit can never pay, but where one person will exercise his intelligence to understand the description of a new natural fact or principle a thousand are ready to admire the high purpose of a scientific quest and reverence the

disinterested service rendered by it to humanity. The record of discovery or description of progress is, therefore, only one function of a local scientific society; beyond this is the duty of using the light of science to reveal the dangers of ignorance in high as well as in low places. Though in most societies there is only a small nucleus of working members, the others are capable of being interested in results achieved, and a few may be so stimulated by them as to become just and worthy knights of science, ready to remove any dragons which stand in the way of human progress, and continually upholding the virtues of their mistress.

Every local scientific society should be a training ground for these Sir Galahads, and an outpost of the empire of knowledge. The community should look to it for protection from dangers within and without the settlement, and for assistance in pressing further forward into the surrounding woods of obscurity. At present it is unusual for this civic responsibility to be accepted by a scientific society, with the result that local movements are undertaken without the guidance necessary to make them successful. A local scientific society should be the natural body for the civic authority to consult before any action is taken in which scientific knowledge will be of service. It should be to the city or county in which it is situated what the Royal Society is to the State, and not a thing apart from public life and affairs. As an example of what a local society may usefully do, the action taken by the Manchester Field Naturalists' and Archæologists' Society several years ago may be mentioned. The Society appointed a Committee for the purpose of promoting the planting of trees and shrubs in Manchester and its immediate suburbs. The idea commended itself to the Corporation, and the Committee obtained advice as to the best trees for open spaces in the district, shrubs for tubs and boxes, and tree culture in towns generally. This is the kind of guidance which a scientific society should be particularly competent to give, and which the community has a right to expect from it. Many similar questions continually arise in which ascertained knowledge can be used for the promotion of healthy individual and social life, and if scientific societies are indifferent to them they neglect their best opportunities of playing a strong part in the scheme of human progress.

When wisdom is justified of her children, and local scientific societies are no longer esoteric circles, but effective groups of enlightened citizens of all classes, they will provide the touchstone by which fact is distinguished from assertion and promise from performance. As the sun draws into our system all substantial bodies which come within its sphere of influence, while the pressure of sunlight drives away the fine dust which would tend to obscure one body from another, so a local scientific society possesses the power of attracting within itself all people of weight in the region around it and of dispersing the mist and fog which commonly prevail in the social atmosphere. Thus may the forces of modern civilization, moral and material, be brought together, and an allied plan of campaign instituted against the armies of ignorance and sloth. The service is that of truth, the discipline that of scientific investigation, and the unifying aim human well-being. Kingsley long ago expressed the democratic basis upon which this fellowship is founded. "If," he said, "you want a ground of brotherhood with men, not merely in these islands, but in America, on the Continent—in a word, all over the world—such as rank, wealth, fashion, or other artificial arrangements of the world can not give and can not take away; if you want to feel yourself as good as any man in theory, because you are as good as any man in practice, except those who are better than you in the same line, which is open to any and every man, if you wish to have the inspiring and ennobling feeling of being a brother in a great freemasonry which owns no difference of rank, of creed, or of nationality—the only freemasonry, the only International League which is likely to make mankind (as we all hope they will be some day) one—then be-

come men of science. Join the freemasonry in which Hugh Miller, the poor Cromarty stonemason, in which Michael Faraday, the poor bookbinder's boy, became the companions and friends of the noblest and most learned on earth, looked up to by them not as equals merely, but as teachers and guides, because philosophers and discoverers."

When Kingsley delivered this message artisans were crowding in thousands to lectures in Manchester and other populous places by leaders in the scientific world of that time. Labor then welcomed science as its ally in the struggle for civil rights and spiritual liberty. That battle has been fought and won, and subjects in bitter dispute fifty years ago now repose in the limbo of forgotten things. There is no longer a conflict between religion and science, and labor can assert its claims in the market-place or council house without fear of repression. Science is likewise free to pursue its own researches and apply its own principles and methods within the realm of observable phenomena, and it does not desire to usurp the functions of faith in sacred dogmas to be perpetually retained and infallibly declared. The Royal Society of London was founded for the extension of *natural* knowledge in contra-distinction to the *supernatural,* and it is content to leave priests and philosophers to describe the world beyond the domain of observation and experiment. When, however, phenomena belonging to the natural world are made subjects of supernatural revelation or uncritical inquiry, science has the right to present an attitude of suspicion towards them. Its only interest in mysteries is to discover the natural meaning of them. It does not need messages from the spirit world to acquire a few elementary facts relating to the stellar universe, and it must ask for resistless evidence before observations contrary to all natural law are accepted as scientific truth. If there are circumstances in which matter may be divested of the property of mass, fairies may be photographed, lucky charms may determine physical events, magnetic people disturb compass needles, and so on, by all means let them be investigated, but the burden of proof is upon those who believe in them and every witness will be challenged at the bar of scientific opinion.

We do not want to go back to the days when absolute credulity was inculcated as a virtue and doubt punished as a crime. It is easy to find in works of uncritical observers of mediæval times most circumstantial accounts of all kinds of astonishing manifestations, but we are not compelled to accept the records as scientifically accurate and to provide natural explanations of them. We need not doubt the sincerity of the observer even when we decline to accept his testimony as scientific truth. The maxim that "Seeing is believing" may be sound enough doctrine for the majority of people, but it is insufficient as a principle of scientific inquiry. For thousands of years it led men to believe that the earth was the center of the universe, with the sun and other celestial bodies circling round it, and controlling the destiny of man, yet what seemed obvious was shown by Copernicus to be untrue. This was the beginning of the liberation of human life and intellect from the maze of puerile description and philosophic conception. Careful observation and crucial experiment later took the place of personal assertion and showed that events in Nature are determined by permanent law and are not subject to haphazard changes by supernatural agencies. When this position was gained by science, belief in astrology, necromancy, and sorcery of every kind began to decline, and men learned that they were masters of their own destinies. The late War is responsible for a recrudescence of these mediæval superstitions, but if natural science is true to the principles by which it has advanced it will continue to bring to bear upon them the piercing light by which civilized man was freed from their baleful consequences.

There is abundant need for the use of the intellectual enlightenment which science can supply to counteract the ever-present tendency of humanity to revert to primitive ideas. Fifty years of compulsory education are but

a moment in the history of man's development, and their influence is as nothing in comparison with instincts derived from our early ancestors and traditions of more recent times grafted upon them. So little is known of science that to most people old women's tales or the single testimony of a casual onlooker are as credible as the statements and conclusions of the most careful observers. Where exact knowledge exists, however, to place opinion by the side of fact is to blow a bubble into a flame. Within its own domain science is concerned not with belief—except as a subject of inquiry—but with evidence. It claims the right to test all things in order to be able to hold fast to that which is good. It declines to accept popular beliefs as to thunderbolts; living frogs and toads embedded in blocks of coal or other hard rock without an opening, though the rock was formed millions of years ago and all fossils found in it are crushed as flat as paper; the inheritance of microbic diseases; the production of rain by explosions when the air is far removed from its saturation point; the influence of the moon on the weather or of underground water upon a twig held by a dowser, and dozens of like fallacies, solely because when weighed in the balance they have been found wanting in scientific truth. Its only interest in mysteries is that of inquiring into them and finding a natural reason for them. Mystery is thus not destroyed by knowledge but removed to a higher plane.

Never let it be acknowledged that science destroys imagination, for the reverse is the truth. "The Gods are dead," said W. E. Henley.

> The world, a world of prose,
> Full-crammed with facts, in science swathed and sheeted,
> Nods in a stertorous after-dinner doze!
> Plangent and sad, in every wind that blows
> Who will may hear the sorry words repeated:—
> "The Gods are dead."

It is true that the old idols of wood and stone are gone, but far nobler conceptions conceptions have taken their place. The universe no longer consists of a few thousand lamps lit nightly by angel torches, but of millions of suns moving in the infinite azure, into which the mind of man is continually penetrating further. Astronomy shows that realms of celestial light exist where darkness was supposed to prevail, while scientific imagination enables obscure stars to be found which can never be brought within the sense of human vision, the invisible lattice work of crystals to be discerned, and the movements of constituent particles of atoms to be determined as accurately as those of planets around the sun. The greatest advances of science are made by the disciplined use of imagination; but in this field the picture conceived is always presented to Nature for approval or rejection, and her decision upon it is final. In contemporary art, literature, and drama imagination may be dead, but not in science, which can provide hundreds of arresting ideas awaiting beautiful expression by pen and pencil. It has been said that the purpose of poetry is not truth, but pleasure; yet, even if this definition be accepted, we submit that insight into the mysteries of Nature should exalt, rather than repress, the poetic spirit, and be used to enrich verse, as it was by some of the world's greatest poets—Lucretius, Dante, Milton, Goethe, Tennyson, and Browning. With one or two brilliant exceptions, popular writers of the present day are completely oblivious to the knowledge gained by scientific study, and unmoved by the message which science is alone able to give. Unbounded riches have been placed before them, yet they continue to rake the muck-heap of animal passions for themes of composition. Not by their works shall we become "children of light," but by the indomitable spirit of man ever straining upwards to reach the stars.

Where there is ignorance of natural laws all physical phenomena are referred to supernatural causes. Disease is accepted as Divine punishment to be met by prayer and fasting, or the act of a secret enemy in communion with evil spirits. Because of these beliefs thousands of innocent people were formerly burnt and tortured as witches and

sorcerers, while many thousands more paid in devastating pestilences the penalty which Nature inevitably exacts for crimes against her. In one sense it may be said that the human race gets the diseases it deserves; but the sins are those of ignorance and neglect of physical laws rather than against spiritual ordinances. Plague is not now explained by supposed iniquities of the Jews or conjunctions of particular planets, but by the presence of an organism conveyed by fleas from rats; malaria and yellow fever are conquered by destroying the breeding places of mosquitoes; typhus fever by getting rid of lice; typhoid by cleanliness; tuberculosis by improved housing; and most like diseases by following the teachings of science concerning them. Though the mind does undoubtedly influence the resistance of the body to invasion by microbes, it can not create the specific organism of any disease, and the responsibility of showing how to keep such germs under control, and prevent, therefore, the poverty and distress due to them, is a scientific rather than a spiritual duty.

The methods of science are pursued whenever observations are made critically, recorded faithfully, and tested rigidly, with the object of using conclusions based upon them as stepping-stones to further progress. They demand an impartial attitude towards evidence and fearless judgment upon it. These are the principles by which the foundations of science have been laid, and a noble structure of natural knowledge erected upon them. A scientific inquiry is understood to be one undertaken solely with the view of arriving at the truth, and this disinterested motive will always command public confidence. It is poles apart from the spirit in which social and political subjects are discussed: it is the rock against which waves of emotion and storms of rhetoric lash themselves in vain. If political science were guided by the same methods it would present an open mind to all sides of a question, weighing objections to proposals as justly as reasons in support of them, whereas usually it sees only the views of a particular class or party, and can not be trusted, therefore, to strike a judicial balance. The methods of science should be the methods applied to social problems if sound principles of progress are to be determined. When they are so used a statesman will be judged, as a scientific man is judged, by correct observation, just inference, and verified prediction; in their absence politics will remain stranded on the shifting sands of barter, concession, and expediency.

Democracy may be politically an irrational force, but that is all the more reason why those who direct it should have full knowledge of the possibilities offered by science for construction as well as for destruction. In a chemical research an experiment is not the haphazard mixture of substances made in the hope that something good will come from it, but the deliberate test of consequences which ought to follow if certain ideas are true. So with all scientific experiment: reason is the source of action, and principles are tested by results. Social problems are perhaps more complicated than those of the laboratory, yet the only way to discover solutions of them is to apply scientific standards to the methods used and results obtained. Laws of Nature are merely expressions of our knowledge at a particular epoch, and they are more precise than those of political economy because they are investigated purely from the point of view of progress. If the general laws which constitute the science of sociology are to be discovered and accepted, their study must be as impartial as that of any other science. "The discovery of exact laws," said W. K. Clifford, "has only one purpose—the guidance of conduct by means of them. The laws of political economy are as rigid as those of gravitation; wealth distributes itself as surely as water finds its level. But the use we have to make of the laws of gravitation is not to sit down and cry 'Kismet' to the flowing stream, but to construct irrigation works."

Organized Labor has on more than one occasion pronounced a benison upon scientific research, and urged that full facilities should be afforded to those who undertake it.

Not long ago the American Federation of Labor in convention assembled resolved 'that a broad programme of scientific and technical research is of major importance to the national welfare,' and in a noteworthy document insisted upon its essential value in the development of industries, increased production, and the general welfare of the workers. The British Labor Party has also stated that it places the 'advancement of science in the forefront of its political programme,' but its manifesto refers particularly to the 'undeveloped science of society' rather than to the science of material things; and whatever labor may declare officially, it is scarcely too much to say that artisans in general show less active interest in scientific knowledge now than they did fifty years ago. Not by the study of science does a manual worker become a leader among his fellows but by the discovery of wrongs to be remedied or rights to be established, and by fertility of resource in disputations concerning them. This is natural enough, yet when we remember that many of the greatest pioneers in the fields of pure and applied science were of humble origin it is surprising that labor makes no effort to keep men of this type within its lodges.

If trades unions were true to their title, and not merely wage unions, their members would give as much attention to papers on scientific principles of their industry, craftsmanship, and possible new developments as they do to the consideration of the uttermost they can claim and secure for their members. Not a single labor organization concerns itself with actual means of industrial progress, but only with the sharing of the profits from processes or machinery devised by others. Labor may express approval of scientific and technical research, but if it wishes to be a creative force it should take part in this work instead of limiting itself to getting the greatest possible advantage from the results. Under present conditions an artisan with original ideas or inventive genius has to go outside the circle of his union to describe his work, and he thus becomes separated from his fellows through no fault of his own. His contributions are judged by a scientific or technical society purely on their merit and without any consideration as to his social position. Labor can never be great until it affords like opportunities to its own original men by accepting and issuing papers upon discoveries of value to science and industry. When it does this, and its publications occupy an honored place among those of scientific and technical societies, it will be able to command a position in national polity which can never be justly conceded to any organization concerned solely with the rights and privileges of a single class in the community.

We know, of course, that few workmen can be expected to possess sufficient knowledge and originality to make developments important enough to be recorded in papers for the benefit of science or industry generally, but every such contribution published by a trade union or other labor organization, federated or otherwise, would do far more to command respect than sheaves of pamphlets upon economic aspects of industry from the point of view of workpeople. If no fundamental or suggestive papers of this kind are forthcoming, or if organized labor persists in its policy of letting its men of practical genius find elsewhere the people who know how to appreciate them, it is tacitly acknowledged that others are expected to provide the seeds of industrial developments while labor concerns itself solely with the distribution of the fruits derived from them.

It is true that some of the leaders of the labor movement realize that close association with progressive science is essential to the expansion of industry and the consequent provision of wages in the future. What is here urged is that labor should itself take part in the scientific and industrial research which it acknowledges is necessary for existence, and should show by its own contributions that it possesses the power to produce useful knowledge as well as the dexterity to apply it. The machinery of trade unionism is capable of much more extensive use than

that to which it has hitherto been put, and when it is concerned not only with securing "for the producers by hand or by brain the full fruits of their industry," but also with the creation of new plantations by its own efforts, no one will be able to doubt its fitness to exercise a controlling influence upon modern industry.

The Workers' Educational Association has proved that very many artisans are ready to take advantage of opportunities of becoming familiar with the noblest works of literature, science, and art, with the single motive of enriching their outlook upon life. Many more attend classes in economics, and nearly all are in favor of extended facilities for further education, though there is a difference of intention between the Marxian element in labor and the more impartial supporters of the W. E. A. or of the Co-operative Education Union. "There is practically no limit," says Mr. G. D. H. Cole in "An Introduction to Trade Unionism," "to what could be done if there only existed among the national and local leaders of Labor a clear idea of the part which education must play if the working-class is ever to achieve emancipation from the wage system." To education should be added original research if labor is to signify something more than a class of hewers of wood and drawers of water. The Guild movement represents a step in this direction, but if it signifies merely a return to the mediæval system it can scarcely be so important a factor of general development as its advocates imagine, and it may mean the institution of caste in labor. Such a system no doubt leads to perfection of craftsmanship, and it is to be welcomed as an antidote to the deadening influence of specialized industry; but a caste nation at last becomes stationary, for in each caste a habit of action and a type of mind are established which can only be changed with difficulty. What is wanted to make the race strong is cross-fertilization, and not inbreeding.

Local scientific societies should provide a common forum where workers with hand or brain can meet to consider new ideas and discuss judicially the significance of scientific discovery or applied device in relation to human progress. At present such societies are mostly out of touch with these practical aspects of knowledge, and are more interested in prehistoric pottery than in the living world around them. Most of those connected with the British Association are concerned with natural history, but all scientific societies in a district should form a federation to proclaim the message of knowledge from the house-tops. Men are ready to listen to the gospel of science and to believe in its power and its guidance, but its disciples disregard the appeal and are content to let others minister to the throbbing human heart. Civilization awaits the lead which science can give in the name of wisdom and truth and unprejudiced inquiry into all things visible and invisible, but the missionary spirit which would make men eager to declare this noble message to the world has yet to be created.

This is as true of the British Association itself as it is of local scientific societies. It seems to be forgotten that one of the functions of the Association is to inspire belief and confidence in science as the chief formative factor of modern life, and not only to display discoveries or enable specialists to discuss technical advances in segregated sections. Though members of the Association may be able to live on scientific bread alone, most of the community in any place of meeting need something more spiritual to awaken in them the admiration and belief which beget confidence and hope. They ask for a trumpet-call which will unite the forces of natural and social science, and are unmoved by the parade of trophies of scientific conquests displayed to them. It was the primary purpose of Canon W. V. Harcourt, the chief founder of this Association, and General Secretary from 1831 to 1837, to sound this note for "the stimulation of interest in science at the various places of meeting, and through it the provision of funds for carrying on research," and not for "the discussion of scientific subjects in the sections." In the course of time these sectional discussions have taken

a prominent place in the Association's programme, and rightly so, for they have promoted the advancement of science in many directions; but, while we recognize their value to scientific workers, we plead for something more for the great mass of people outside the section-rooms, for a statement of ideals and of service, of the strength of knowledge and of responsibility for its use. These are the subjects which will quicken the pulse of the community and convert those who hate and fear science and associate it solely with debasing aspects of modern civilization into fervent disciples of a new social faith upon which a lever made in the workshops of natural knowledge may be placed to move the world.

RICHARD GREGORY

A NOTABLE MATHEMATICAL GIFT

As trustee of the Edward C. Hegeler Trust fund Mrs. Mary Hegeler Carus, of La Salle, Illinois, recently promised to make the Mathematical Association of America a yearly contribution of twelve hundred dollars for five years to be used for the publication of mathematical monographs under the auspices of this association. As is well known the publication of scientific literature has been much hampered in recent years by the greatly increased cost of publication. Hence this gift is especially timely and noteworthy.

The letter confirming this gift was addressed to Professor Slaught, of the University of Chicago, and includes the following significant statement:

> If at the end of five years this project shall have proved successful it is my intention to then give to the Association a permanent endowment fund, and I will so direct my legal representatives, which will yield at least twelve hundred dollars annually.

As the great success of the project seems practically assured in view of the wide and deep interest already manifested therein on the part of leading mathematicians the Mathematical Association of America seems to have good reasons for expecting a substantial permanent endowment to aid it in the futherance of its great cause of improving collegiate mathematics.

There are now three national mathematical organizations in America. The oldest of these is the American Mathematical Society, which was organized in 1888 as the New York Mathematical Society, but was reorganized about six years later under its present name. This Society devotes most of its energies to mathematical research, and, to further this cause, Professor L. L. Conant, who died in 1916, bequeathed to it ten thousand dollars, subject to Mrs. Conant's life interest, the income of which is to be offered once in five years as a prize for original work in pure mathematics.

The Mathematical Association of America was organized in 1915 with a view towards supplementing the work of the American Mathematical Society along the line of collegiate teaching. It has always collaborated with the Society holding joint meetings with it and having a large common membership. The gift announced above will make it possible to collaborate still more effectively in promoting the interests of advanced mathematics in this country. The National Council of Teachers of Mathematics, organized in 1920, is mainly devoted to the interests of the teaching of secondary mathematics and hence represents more distinctly a separate field, but it too has already begun to cooperate with the Mathematical Association of America.

The latter organization took steps several years ago towards the publication of a modern mathematical dictionary and has a standing committee on this subject. It has, however, not yet been able to push this laudable enterprise on account of lack of funds. The difficulty of such a work is increased by the fact that at present there exists no good mathematical dictionary in any language, and hence most of the material for such a work has to be collected from original sources.

G. A. MILLER

UNIVERSITY OF ILLINOIS

A NEW ALASKA BASE MAP

THE U. S. Coast and Geodetic Survey of the Department of Commerce reports the completion of a new outline map of Alaska on the Lambert conformal conic projection,

scale 1/5,000,000; dimensions $17 \times 26\frac{1}{2}$ in., price 25 cents.

The map extends from the Arctic Ocean in the north to the State of Washington in the south, and includes all of the Aleutian Islands and a part of Eastern Siberia. It is intended merely as a base map to which may be added any kind of special information that may be desired. For this reason only national boundaries, the adjacent Canadian provinces, and the names of a few of the important towns are given. The shoreline is compiled from the most recent Coast and Geodetic Survey charts and in respect to southeast Alaska and westward to Kodiak Island, the coast-line is better represented than heretofore. The accumulation of the yearly surveys in the extensive and largely unsurveyed waters of Alaska as here embodied, presents a delineation of the coastline in a more really true shape than heretofore and in this respect the map is more reliable than other existing maps of similar scale.

In addition to this feature, the employment of a more suitable system of map projection adds to the general accuracy. On account of the predominating east and west extent of Alaska, the Lambert conformal conic projection with two standard parallels offers advantages over other projections formerly used in mapping this region. This is the system which came to prominent notice during the World War and was employed by the allied forces in their military operations in France.

The parallels employed as standards are the latitudes 55° and 65°, and along these parallels the scale is true. Between these parallels the scale becomes too small by less than four-tenths of one per cent., which amount is insignificant. At Dixon entrance in southeast Alaska, the former general chart of Alaska on a polyconic projection was in error by as much as ten per cent. due to a system of projection which was unsuited to the shape of the area involved. In the new base map, the projection error in this locality is entirely eliminated. The maximum error of scale of the Lambert projection is only 1 3/4 per cent. This is in the latitude of Pt. Barrow in the north where the scale is too large by this amount. The same amount of error appears in latitude 48° but this is considerably south of Alaska, which is the subject of the map. The polyconic projection had the effect of exaggerating areas in the most important part of Alaska whereas in the Lambert projection the maximum scale error is placed in the least important part of Alaska, and in amount is only one sixth as large as in the polyconic projection.

For the measurement of distances and areas within the extent of the map, an accuracy is thus obtained that is well within the limits of draftsmanship, paper distortion, and our knowledge of this region as a whole.

The selection of a suitable projection with a conformal grid system of one degree units, makes the new outline map a convenient base for the addition of special and useful information. The inclusion of the northwest part of the state of Washington serves as a connecting link with a similar Lambert conformal base map of the United States which has already been published on the same scale.

SCIENTIFIC EVENTS

INVESTIGATIONS OF THE U. S. BUREAU OF MINES ON OZONE AND VENTILATION

The Pittsburgh Experiment Station of the United States Bureau of Mines, according to a bulletin of the bureau, is working in cooperation with the Research Bureau of the American Society of Heating and Ventilating Engineers on a number of problems which affect each individual in his home life, in his place of business, and especially in those places where many people congregate, as in churches, school-rooms and theaters. It is important to ventilate such places with sufficient fresh air to make every one comfortable enough to be able to work at high efficiency. The circulation of excessive quantities of fresh air imposes a considerable cost on the heating system, therefore an efficiently designed heating and ventilating system introduces the least amount of cooled air con-

sistent with proper conditions for health. In this connection the use of ozone has frequently been proposed and actually tried in a number of places. The ozone is supposed to deodorize and purify the air by the oxidation of organic matter and possibly by killing bacteria.

It is, however, a question as to whether ozone can be introduced in quantities large enough to kill bacteria without producing very serious irritation of the throat and lung tissues. It is also a question as to whether harmful oxides of nitrogen are not produced simultaneously with ozone. Definite information is needed on this subject. The first step in obtaining such information is to work out methods for accurately determining the percentage of ozone and oxides of nitrogen produced for different types of ozone machines and to develop suitable methods for determining the very small quantities of ozone and oxides of nitrogen that may be present in air treated with such machines. Analytical work of the highest precision is required. The gas laboratory of the Bureau of Mines Pittsburgh Experiment Station is now engaged on this problem, working in cooperation with the Research Bureau of the American Society of Heating and Ventilating Engineers which is housed in the same building.

After the chemists have worked out the methods of detecting and analysing these small quantities of ozone and oxides of nitrogen, the next problem will be undertaken in a like cooperation of the two agencies just named working with the United States Public Health Service. Surgeons from this service are detailed to the Bureau of Mines for working on health and sanitation problems. The work is being carried on under the joint general direction of A. C. Fieldner, supervising chemist and superintendent of the Pittsburgh Station of the Bureau of Mines, and Dr. R. R. Sayers, chief surgeon of the Bureau of Mines, by G. W. Jones, assistant gas chemist, W. P. Yant, assistant analytical chemist, and O. W. Armspach, engineer of the American Society of Heating and Ventilating Engineers.

THE PUEBLO BONITO EXPEDITION OF THE NATIONAL GEOGRAPHIC SOCIETY

Neil M. Judd, curator of American archeology in the U. S. National Museum, has returned to Washington from New Mexico where he has been engaged, during the past five months, as director of the National Geographic Society's Pueblo Bonito Expedition. This first summer's explorations in Pueblo Bonito—one of the largest and best preserved prehistoric ruins in the United States—is reported to have been entirely successful and to have prepared the way for more intensive research next season. Over forty dwellings and five large ceremonial rooms were excavated; a considerable collection of artifacts and much valuable data were recovered.

As a unique feature of the National Geographic Society's newest expedition it is proposed to hold an annual symposium at Pueblo Bonito—a conference to which will be invited leaders in various branches of science. The first of these meetings, held late in August, was attended by several archeologists and agriculturists; geologists, botanists and soil experts will be invited to the next conference. Through the willing cooperation of these specialists, each expert in his own branch of science, it is hoped to gain a deeper understanding of the conditions under which the ancient inhabitants of Pueblo Bonito carried on their numerous activities; *i.e.*, the geophysical conditions which obtained in their day, the source and extent of their water supply, their methods of agriculture, the character and variety of their foodstuffs, as well as an index as to their cultural attainments, through careful examination of the archeological data recovered. This is the first instance, it is believed, in which American men of widely differing fields of science have joined in solution of a common problem.

THE STEELE CHEMICAL LABORATORY OF DARTMOUTH COLLEGE

At the dedication of the Steele Chemical Laboratory, according to the account in the Boston *Transcript,* the assembly included Governor Albert A. Brown of New Hampshire, former Governor Pingree of Vermont, Dean

Henry P. Talbot of the Massachusetts Institute of Technology, Dr. William H. Nichols of New York City, members of the board of trustees of Dartmouth College, and a number of prominent chemists of New England. Addresses were made by Dr. Nichols, who spoke of the late Sanford H. Steele, a former associate in the General Chemical Company, and an alumnus of Dartmouth, whose bequest of $250,000 made the new building possible, and by Dean Talbot, who reviewed the outstanding achievements of the last fifty years in the study of chemistry.

The Steele chemistry building, which has just been completed at a cost of half a million dollars, embodies the best features of over a score of laboratories inspected by the architects and members of the Dartmouth chemistry department. Much of the apparatus of its equipment has been specially constructed according to designs of Dartmouth chemists.

Nine laboratory rooms are contained in the building, varying from the large laboratory for beginners which will accommodate 144 men working at one time to the laboratory for advanced organic chemistry which will accommodate about fifteen men. Laboratories for qualitative analysis, quantitative analysis, physiological chemistry, physical chemistry, organic chemistry and advanced courses in each of these studies are included. The new building also contains offices and laboratory suites for instructors and professors as well as a large library, lecture room, and conductivity rooms. Specially designed and constructed systems for ventilation, and distribution of gas, electricity, compressed air and distilled water have been installed. The building is Georgian in type, to harmonize with other Dartmouth buildings. It was designed by Larson & Wells of Hanover, and erected by the Cummings Construction of Ware, Mass.

Members of the Ouroborus Club, a society of chemists, holding its fall meeting at Hanover, were guests at the dedication exercises and included Professors Talbot, Norris, Moore, Williams, Smith and Lewis of the Massachusetts Institute of Technology; Kohler and Lamb, of Harvard; Jennings and Zinn, of Worcester; Hopkins, Doughty and Scatchard, of Amherst; Chamberlain and Morse of Massachusetts Agricultural College; Mears of Williams; Johnson of Yale; Hoover of Wesleyan; and Bartlett, Bolser and Richardson of Dartmouth.

LECTURES ON PUBLIC HYGIENE AT THE UNIVERSITY OF PENNSYLVANIA

A second series of ten lectures on "Public Hygiene" to be given under the auspices of the school of Hygiene and Public Health at the University of Pennsylvania is announced as follows: October 15. "The factors that determine disease and death." Professor D. H. Bergey, School of Hygiene and Public Health, University of Pennsylvania.

October 22. "The organization of community anti-tuberculosis work." G. T. Drolet, Statistician, N. Y. Tuberculosis Commission.

October 29. "The sanitary control of food and drink in Philadelphia." Professor Seneca Egbert, School of Hygiene and Public Health, University of Pennsylvania.

November 5. "The anti-venereal campaign." T. C. Funck, Pennsylvania Department of Health.

November 12. "Social service as a factor in public health activities." Dr. H. R. M. Landis, director of the Clinical and Sociological Department, Henry Phipps Institute.

November 19. "Infective diseases not caused by bacteria, their nature, spread and suppression." Professor A. J. Smith, professor of pathology, University of Pennsylvania.

November 26. "The administration of public health laboratories." Dr. John Laird, director of the laboratory of Pennsylvania State Department of Health.

December 3. "Medical examination and classification of workmen as complementing the sanitary supervision of workplace." Dr. Frank Craig, Henry Phipps Institute.

December 10. "The limitations of Eugenics." By Professor C. E. McClung, professor of zoology and director of the laboratory of zoology, University of Pennsylvania.

December 19. "On the training of public

health officials and the opportunities for using such training." Dr. John A. Ferrell, International Health Board, Rockefeller Foundation.

THE LANE MEDICAL LECTURES OF STANFORD UNIVERSITY

Dr. L. Emmett Holt, emeritus professor of pediatrics of the College of Physicians and Surgeons of Columbia University, will deliver the Lane Medical Lectures in the Stanford University Medical School, San Francisco, from December 5 to 10. The lectures will take place daily at 8 P. M. The topics will be as follows:

I. The general subject of nutrition—its importance in relation to health and growth, to progress in school, to resistance to infection and in the management of acute and chronic disease.
II. The food requirements of the healthy child after infancy.
III. The function in diet of fat, protein, carbohydrate and mineral salts, and the conditions which determine the amounts needed.
IV. Vitamines—Their function in nutrition and the new point of view which they have given regarding food values.
V. The practical problem of improving the nutrition of children including the prevention and treatment of malnutrition.

Dr. Holt will also give a clinic on children's diseases on Wednesday, December 7, at 11:30 A.M., at the Medical School.

THE TORONTO MEETING OF THE AMERICAN SOCIETY OF NATURALISTS

The thirty-ninth annual meeting of the American Society of Naturalists will be held in Toronto, Canada, on Thursday, December 29, 1921, under the auspices of the University of Toronto.

Headquarters of the society will be the King Edward Hotel, 37–55 East King Street, where the American Society of Zoologists and the Botanical Society of America will also have headquarters. Members desiring accommodations at headquarters should make reservations early. Accommodations may also be obtained at other hotels and probably also at the dormitories of the university and near-by fraternity houses. Information concerning these accommodations will be given later in Science or in the final announcement in December.

On Thursday forenoon a limited number of short papers by members and invited guests will be given. Members desiring to present papers should send the titles to the secretary not later than November 24, giving estimated time of delivery, and requirements of lantern, charts, blackboard space, etc. It should be remembered that the primary interest of the society, as expressed in resolutions, is in evolution in its broadest sense.

Thursday afternoon is to be devoted to the annual symposium. The general subject in 1921 is "The Origin of Variations," and the following speakers have been secured:

H. S. Jennings—Variation in Uniparental Reproduction.

A. F. Blakeslee—Variations in Datura due to Changes in Chromosome Number.

H. J. Muller—Variation due to Change in Individual Genes.

C. B. Bridges—The Origin of Variations in Sexual and Sex-Limited Characters.

R. A. Emerson—The Nature of Bud Variations as Indicated by the Mode of their Inheritance.

M. F. Guyer—Serological Reactions as a Probable Cause of Variations.

The naturalists' dinner will be given on Thursday evening. The annual address of the president will follow.

The American Association and most of the affiliated societies will meet in Toronto. Attention is called to cooperation of the naturalists with the Botanical Society of America and the American Society of Zoologists, whereby the latter two societies list their papers on subjects of greatest interest to the naturalists on the day preceding the naturalists' program.

Section G (Botany) of the American Association will present on Wednesday afternoon a symposium on the "Utility of the Species Concept," in which the speakers are Charles F. Millspaugh, George H. Shull, R. A. Harper, Guilford B. Reed, and E. C. Stakman.

The American Society of Zoologists has ar-

ranged a symposium on "Orthogenesis," to be participated in by L. J. Henderson, C. B. Lipman, M. F. Guyer, William Bateson, W. M. Wheeler and H. F. Osborn. This symposium will be given on Friday, possibly beginning in the forenoon.

A. FRANKLIN SHULL, *Secretary*
UNIVERSITY OF MICHIGAN,
ANN ARBOR, MICHIGAN

SCIENTIFIC NOTES AND NEWS

DR. HARLOW SHAPLEY, formerly of the Mount Wilson Solar Observatory, has been appointed director of the Harvard College Observatory in succession to the late Edward C. Pickering.

DR. JOEL STEBBINS has been appointed director of the Washburn Observatory and professor of astronomy at the University of Wisconsin, beginning on July 1, 1922, to succeed Professor George C. Comstock, who has been director of the observatory since 1889 and has reached the age of retirement. Professor Comstock will carry on his work as director of the observatory during the present academic year, while Dr. Stebbins will act as non-resident professor of astronomy. Dr. Stebbins has been a member of the department of astronomy at the University of Illinois since 1903 and director of the observatory since 1913. Professor Comstock has been a member of the Wisconsin faculty since 1887 and, besides being director of Washburn Observatory for 32 years, was dean of the Wisconsin Graduate School from 1906 to 1920.

DR. EDGAR F. SMITH, provost emeritus of the University of Pennsylvania, has been elected an honorary member of the French Society of Chemical Industry, and also an honorary member of the Chemical, Metallurgical and Mining Society of South Africa.

WILFRID KILIAN, professor of geology in the University of Grenoble in the Dauphiné, France, has been awarded the Gaudry gold medal, the highest distinction of the Société Geologique de France.

AT the opening of the annual meeting of the French Society of Chemical Industry on October 10, the Dumas medal of the society and an illuminated address were presented by M. Dior, minister of commerce, to Sir William J. Pope.

DR. HIKO MATSUMOTO, who until a few weeks ago was studying the Fayûm collection of Proboscidea in the American Museum, recently received the prize of the Imperial Institution of Science and Literature of Japan.

THE French Geological Society met, from September 14 to 20, in Savoie, under the presidency of M. G. Révil and with the assistance of MM. Morel, Le Roux and Kilian. A number of excursions were made.

AT its 1921 meeting in New Orleans, the American Pharmaceutical Association awarded the 1921–22 grant from the A.Ph.A. Research Fund to Dr. David I. Macht, of Johns Hopkins University, for pharmacological work on the benzyl compounds found in certain galenicals. The first grant made in 1919 was awarded to Dr. George D. Beal, of the University of Illinois, for work on alkaloidal assays, while the 1920 award was made jointly to Dr. Heber W. Youngken, of the Philadelphia College of Pharmacy and Sciences, for work on aconite varieties and Dr. E. Kremers and Miss Lila Winkelblech, of the school of pharmacy of the University of Wisconsin, for work on derivatives of guaiacol.

DR. KIRTLEY F. MATHER, professor of geology at Denison University, Granville, Ohio, lectured before the Geographical Society of Chicago on October 28. His subject was "Andine trails and jungle streams, the search for oil in Bolivia." Dr. Mather spent the greater part of the year 1920 in exploration along the eastern front of the Andes in the central portion of South America. On his return he resumed his work at Denison University.

PROFESSOR E. J. COHEN, of the University of Utrecht, Holland, was at the Ohio State University for nine days in the early part of October. During this time he delivered three lectures on piezochemistry, two on the

metastability of matter and one on scientific work and education in Holland.

The Thomas Hawksley lecture of the Institution of Mechanical Engineers for the present year was delivered on November 4, by Dr. H. S. Hele-Shaw, who took as his subject "Power Transmission by Oil."

Dr. Julius Hahn, the distinguished meteorologist, long professor at the University of Vienna, died on October 13, at the age of eighty-two years.

The death is announced of Sir William Edward Garforth, known for his pioneer work in connection with safety in coal mines.

A course of lectures and discussions on problems of public health in relation to industrial hygiene will be delivered in the lecture theater of the Royal Institute of Public Health, London, on Wednesdays from October 19 to December 7, 1921.

The Imperial College of Science and Technology, South Kensington, London, with which the Royal School of Mines is incorporated, is offering two research fellowships of £300 a year each, tenable for one year, and possibly renewable for a second year, to aid in carrying out an investigation connected with mining, mining geology, metallurgy, or the technology of oil, which in the opinion of the committee is of sufficient use or promise.

The Board of Regents of the University of Michigan has established two fellowships for graduate students in the Museum of Zoology. These will be known as the Edward C. Hinsdale fellowships, and will be supported by a fund bequeathed to the university by the late Genevieve S. Hinsdale, of Detroit.

Under the directorship of Professor Frank Schlesinger, the Yale University Observatory has been opened to the public on two nights of each week, and one of the domes and telescopes has been fitted up for this purpose. To make use of these facilities, one must write to the director some weeks in advance, enclosing a self-addressed envelope, indicating the preferred date and stating how many there will be in the party. Tickets will then be forwarded, which are valid for that night.

Steps toward the expansion of research work at the Pennsylvania State College were taken at the recent conferences held at the college on the occasion of the inauguration of President John M. Thomas. Resolutions calling for the appointment of a general committee to investigate agricultural research at the college and to recommend future work and its support, were adopted at the agricultural conference. Action taken at the conference for state leaders in the mining, metallurgical and ceramic industries approved the fostering of research work in those lines at the college school of mines. It was the recommendation of each conference that sufficient research funds should be provided by the state legislature in the interest of the people of the state.

Medical treatment by specialists for persons of moderate means is now given at fees which cover merely the cost of service, with the opening on November 1 of a model "pay clinic" at Cornell University Medical College. The clinic, the first of its kind to offer general medical service in New York City, is designed to meet the needs of persons unable to pay high specialists' fees, but who, because they are not paupers, are unable to enjoy the advantages of the charity clinics. The pay clinic will occupy three floors in the wing of the college building formerly occupied by the dispensary. It will be open every afternoon from 1.30 until 4 o'clock, except Sundays and holidays. To serve those who can not afford absence from work in the afternoons, evening clinics will also be open on Tuesdays and Fridays until seven o'clock. The clinics will be under the direction of the Cornell medical faculty. Physicians in the pay clinic will be salaried and every effort will be made to preserve the atmosphere of dignity, privacy and consideration for patients, and the same feeling of personal relationship between physician and patient that characterize private practise. The scientific equipment of the college, its laboratories and x-ray facilities will all be used. The rates for treatment will be as follows: Each visit for examination and

treatment, $1; medicine, laboratory tests, x-ray photographs and other supplies at cost; diagnosis of cases requiring special examinations and study, with group consultation of specialists and diagnosis, $10; thorough health examination to discover possible defects from diseases and to obtain advice regarding personal hygiene, $2.50.

THE next meeting of the International Geodetic and Geophysical Union and of its various sections will be at Rome in 1922.

UNIVERSITY AND EDUCATIONAL NEWS

UNDER the terms of the will of the late Hiram Francis Mills, A.M. (Hon.) '89, of Hingham, $200,000 has been left to Harvard University for the study of the origin and cure of cancer. The fund is to be known as the Elizabeth Worcester Mills Fund in honor of Mr. Mills's wife.

ON account of the increased enrollment in psychology courses in Purdue University, two additional instructors and an assistant have been appointed. The new instructors are: H. C. Townley, A.M. (Wisconsin '21), Peter McCoy, A.M. (Columbia '14), and Dorothy Lee, A.B. (Indiana '21). The present enrollment in general and vocational psychology is approximately 500, of whom 345 are men. Changes in the engineering curricula at Purdue make it possible for an engineering student to take two full years of work in psychology.

AT the University of Pennsylvania in the Medical School, Dr. Glen E. Cullen has been made an associate professor of research medicine. Dr. W. A. Jaquette has been made professor of oral surgery and director of the school of dental hygienists, and Dr. Samuel Goldschmidt has been made assistant professor of physiology.

Three associate professors in the Towne Scientific School have been promoted to full professorships in chemistry. They are Dr. John Frazer, Dean of the Towne Scientific School; Dr. Thomas P. McCutcheon and Dr. Hiram S. Lukens. The trustees have also elected Dr. George A. Piersol emeritus professor of anatomy. Dr. Piersol retired from the professorship of anatomy last spring.

WELTON J. CROOK has resigned as chief metallurgist to the Pacific Coast Steel Co. to accept an appointment as associate professor of metallurgy in Stanford University.

MISS EMMA FRANCIS, who resigned as head of the nutrition laboratory, Battle Creek Sanitarium, last July, has been appointed assistant professor of chemical agriculture in the Experiment Station of Pennsylvania State College.

KENNETH H. DONALDSON has been appointed instructor in ore dressing and mining at the Case School of Applied Science.

PROFESSOR F. E. GUYTON, of the Ohio State University, has been appointed assistant professor of zoology and entomology at the Alabama Polytechnic Institute.

E. EUGENE BARKER has returned from Porto Rico and has accepted a position as associate professor of botany at the University of Georgia.

J. J. O'NEIL has been appointed acting assistant professor of geology at McGill University during the absence of J. A. Bancroft.

DISCUSSION AND CORRESPONDENCE

AN EXPLANATION OF LIESEGANG'S RINGS

TO THE EDITOR OF SCIENCE: Dr. McGuigan seems to be unaware of much recent work on banded precipitates (SCIENCE, July 22). He has come to the conclusion, generally, that in some way, the chromate is attracted from the regions of the gel adjacent to the precipitate. So far this is in accordance with the theory proposed by myself in 1916 and confirmed by a long series of experiments.[1] But Dr. McGuigan's particular hypothesis will not bear examination in detail. He may be right in supposing the attractive force to be that between the silver and chromate ions. But this is not sufficient to explain why the bands form in gelatin and not in agar. Neither is the assumption tenable that the

[1] *Biochem. J.*, 1916, X., 169; 1917, XI., 14; 1920, XIV., 29, 474.

chromate of itself is unable to diffuse in the gelatin. The contrary is easily proved. Moreover, there are a great many precipitates that give bands either in gelatin, agar, silicic acid or even in filter paper and sand. It can not be assumed, in every case, that one of the reagents is fixed. Further, the facts quoted by Dr. McGuigan in support of his hypothesis are inaccurate. Bands of lead chromate can be obtained in gelatin with the right concentrations of lead acetate and potassium dichromate, as also with silver nitrate in the gel and the dichromate in aqueous solution.

Examination of a great many different kinds of precipitate in gels and other media shows that band formation occurs only when the precipitate is extremely finely divided, or, practically, in the colloid state. If the specific surface of the precipitate is insufficient there is no banding. The experiments are made conveniently in test-tubes half filled with gel on which the liquid reagent is poured. As the specific surface increases, at first, bands of denser precipitate are formed in a diffuse column of precipitate extending down the tube. With further increase of specific surface, the bands become more marked, until, eventually, there may be no precipitate between. The formation of bands in a diffuse precipitate absolutely disproves the "supersaturation" theory.

The attractive force, the effect of which is well illustrated in Dr. McGuigan's photograph, is that of adsorption. When the precipitate is sufficiently finely divided it adsorbs the solute from the adjacent zone of gel. More solute diffuses into this zone from the regions of gel more remote, where the concentration of solute has not been diminished. But the solute is adsorbed as fast as it arrives in the neighborhood of the precipitate and is removed from solution by the excess of precipitating reagent. Thus a concentration gradient is set up towards the precipitate, and a considerable region of gel adjacent to the precipitate becomes practically devoid of solute. If the rate of diffusion into the gel of the stronger reagent is sufficient, this reagent will be able to travel through the exhausted zone until it reaches a further region of gel where there is sufficient solute to form another band of precipitate. The increasing distances apart of the bands are due to the diminishing concentrations both of the solute in the gel and of the reagent diffusing in.

The specific surface of the precipitate is influenced by the concentrations of the reaction components, by the nature of the reaction medium and by the presence of electrolytes. Generally, it is determined by the value of N in von Weimarn's somewhat indefinite formula

$$N = K.(P/L),$$

where P is the excess concentration of the substance to be precipitated, L its solubility and K is a factor representing the viscosity of the reaction medium and the physical and chemical complexity of the reaction components in solution. The formula is being investigated further. But it has been shown that the occurrence or non-occurrence, of bands of a given substance in different gels is due to the influence of the reaction medium, and that, by varying its specific surface, a substance can be obtained in the banded form, or not, as desired. For instance, silver chromate and dichromate form bands in gelatin. In agar gel they occur as black ribbon-like crystals up to several centimeters in length. By increasing the specific surface of the precipitate in agar, both salts have been obtained in a banded form even more beautiful than in gelatin.

S. C. Bradford

The Science Museum,
South Kensington,
London, S. W.,

SPECIALIZATION IN THE TEACHING OF SCIENCE

To the Editor of Science: It is somewhat amusing to note Professor Gortner's reference to the settee of science as if it were a thing of the past, and then to find, on an earlier page of the same issue, an advertisement which calls for a professor of zoology and geology.

As a matter of fact, it would not be difficult to find scores of just such mixed professorships and instructorships in colleges all over this country. I think it would be safe to assert that it is only in the larger universities, relatively few in number, that specialization has been carried to anything like the degree suggested.

The cases of the colleges in this state may be cited as examples. In one, geology is taught by a professor of astronomy, in another by a professor of agricultural chemistry; in a third a professor of chemistry teaches mineralogy. And it is only fair to these several professors to say that in each case the instruction given is excellent.

That Maine is not unique in this respect is indicated by notices of vacancies in college faculties that have come to my attention during the past two years. In one case an instructor was needed in chemistry and geology, in another an associate professor in zoology and geology, in colleges one of which was near the Atlantic coast (not in Maine), and the other not far from the Pacific.

In my own teaching experience I held for a number of years a position in which I was expected, and did make a brave attempt, to teach chemistry, geology, botany and zoology, with a little physics thrown in for good measure; this in an institution which would be called a college almost anywhere outside of New England.

There are potent reasons why this condition of affairs exists still, and must go on existing for some time to come, whatever may be said as to its desirability; the most obvious being the limitations placed upon our colleges by lack of money. However, I am not altogether certain that the condition is undesirable.

I realize, of course, that Professor Gortner and I are not thinking of exactly the same thing. His attention is, naturally, on the more advanced courses, in which students are, and should be, in charge of more or less narrow (I use the word in no derogatory sense) specialists; mine is on the more general courses, in the conduct of which teaching ability and personality are at least as important as erudition. There is still a large and important field for the old natural-history type of instructor, and I for one sincerely hope that his species will not soon become extinct.

Freeman F. Burr

Central Maine Power Company,
Augusta

SHARK AND REMORA

To the Editor of Science: The account by Dr. Spaeth in Science of October 21 of symbiotic relations between a shark and a remora recalls some observations made by the writer in San Diego, Cal., in November, 1920. The head of a Tuna Shark, *Isuropsis glauca*, had been cut off by the writer and carried to the laboratory of the Scripps Institution, at La Jolla. After some dissections had been made there was found on the table a small remora, three inches long, that had evidently taken refuge in the mouth or gill-chamber of the shark.

H. W. Norris

Grinnell College

SCIENTIFIC BOOKS

Life of Alfred Newton, Professor of Comparative Anatomy, Cambridge University, 1886–1907. By A. F. R. Wollaston. With a preface by Sir Archibald Geikie. New York: E. P. Dutton & Co., 1921. 332 pp.

The loose organization of English University affairs, the lack of coherence in the scheme of the institutions, have had their advantages and disadvantages. When in Cambridge a number of years ago, I met an eminent writer whose original and heterodox ideas about religion had lately been published in a book. "What do the orthodox divines of the University think of him?" I asked a resident. "They do not even know that he exists!" Perhaps that was a slight exaggeration, but the independence of the teachers is such that they do very nearly as they please, and wax or wane in reputation and even income according to their ability to command attention or win support. The centrifugal tendency has dominated the intellectual life of the place, increasing with the inevitable specialization of modern times. Each department is, as it were, at the end of a long lane, which no one

cares to explore unless particular business calls him.

We are now awaiting the report of the recent Government Commission, which visited Oxford and Cambridge during the last year. As a result of the war, or perhaps we should say of a necessary process hastened by the war, the ancient universities need government support. With support must go responsibility of a new kind, and possibly some sort of unification of the system. Is it possible that definite standards of equipment and teaching will eventually be required, enforced through some process of inspection? These are weighty matters for us here in America, for in many places we stand at the parting of the ways. The old freedom is difficult to maintain in the presence of a population requiring to be educated *en masse*. It matters too much if things are badly or wrongly done. At all hazards, we must maintain our intellectual integrity, but we necessarily sacrifice something of our independence. Does that mean that the best minds will gradually be robbed of their originality, grown prematurely inelastic and old? England, the home of the independent worker, has produced more original thinkers than America, whether we consider the sciences or the arts.

There is another and opposite side to the picture. The strong individuality of the leading English scientific men has had a profound influence on their colleagues, and this has been accentuated by the smallness of the country and consequent ease of communication. Professor Alfred Newton, whose teaching in certain of its aspects seemed so amazingly inadequate, was a very center of light and learning for an ardent group of ornithologists, through whom his influence radiates to this day. His "Dictionary of Birds" has no real competitor, and is one of the indispensable books to students of the subject. Throughout the Biography, here and there, we find a note of half regret that the Professor was so set in his ways, so peculiar, so amazingly conservative. Yet perhaps had he not developed freely in his own manner, his power would not have been so great. His old friend Dr. Guillemard thus sums up his impressions:

> Such strength of individuality I can not recall in any other person I have known. It can safely be said that, having carefully envisaged his question and decided it, no human power could make him alter his mind. Yet one almost hesitates to say it, lest a wrong impression should be conveyed, for he was one of the most lovable of men, and inspired an unusual degree of personal affection in the many young men who frequented his rooms. The influence he exercised upon them was remarkable, not only upon the ornithologists, but upon men like Adam Sedgwick, Bateson, Frank Darwin, Lydekker, and a host of others in different fields. It would, I think, be correct to describe him as the founder of the modern Cambridge scientific school, developing the good seed sown by Henslow, who was to a former generation, I imagine, very much what Newton was to mine.

The statement about the modern scientific school applies of course only to the biological, or more specifically zoological, field. Even in the field of zoology Newton's knowledge was quite limited, but it was extraordinarily exact. His interest in birds was so wide that it led him into various fields, as for instance that of philology. Thus he combined what might be considered narrowness with a remarkable breadth of view, which undoubtedly added greatly to his beneficial influence on his students.

Sir Arthur Shipley, who was a student under Newton, gives a lively account of his lectures:

> Newton's lectures were desperately dry and very formal. The Professor sat before a reading desk and read every word of the discourse from a written manuscript, written in his minute hand with a broad quill, so that all the letters looked the same, like the Burmese script. At long intervals there was drawn the outline of a tumbler. Whenever the Professor came to these outlines he religiously took a sip of water. Whether it was the time of day [1 p. m.] or whether it was that we students were all absorbed in comparative embryology and in morphology, the attendance was always small. I went during my second and third year, and at times was the sole auditor. Not that that made the least difference to the Professor. He steadily and relentlessly read on—"the majority of you now present know," "most of my audience are well aware," and similar phrases left me in considerable doubt

as to what parts of me were "the majority" and which the "most."

About the year 1884, Newton prepared courses of lectures on Geographical Distribution and Evidences of Evolution. He was to lecture on Monday, Wednesday and Friday at noon. He discovered, however, that the lectures, as written, would not stretch over a whole term, so he told the class that next Monday he would unfortunately not be able to lecture owing to urgent business, and this would continue throughout the term.

Dr. Guillemard, in the passage quoted above, has referred to the difficulty of changing Newton's well-considered opinions. It must be added, however, that he was able to keep an open mind on certain subjects of great importance to him. Thus he readily appreciated Darwin's theory at the time of its publication, and only four days after the publication of the Darwin and Wallace papers by the Linnean Society wrote a long letter on the subject to Canon H. B. Tristram. This led to the circumstance that Tristram was the first zoologist of note to publish his adherence to the doctrine, though unfortunately he was reconverted to the old faith shortly after. He also came to see that the old classification of birds was faulty, and recognized the necessity for fundamental revision.

Professor Newton was an ardent field naturalist, and in his earlier days visited the West Indies (St. Croix and St. Thomas), Iceland, Spitzbergen and other countries, always making interesting observations. He did his best to discover the haunts of the great Auk in Iceland, but although he talked with men who had seen it, it was apparently extinct before his visit. He left copious materials for a history of the great Auk, which he intended to publish had his life been prolonged a few more years.

Newton died in 1907, his last wish being "may the study of zoology continue to flourish in the University." Since then, much good and important work has been done, but there is great need for more room, more assistance, more apparatus, and adequate salaries for the staff. The whole British Empire is concerned in this matter, for in such centers must be trained the men who go out to solve the innumerable problems of the dominions and colonies. Nor is it merely a matter of training specialists, for modern life requires that the leaders in all fields shall know something of biology. Thus, even if conditions in Newton's time could have been described as adequate (which they were not), they would no longer suffice for modern needs.

T. D. A. Cockerell
University of Colorado

ACOUSTICAL NOTES

Musical Notation.—The recent interesting letter in Science describing a new musical notation and proposing a new keyboard therefor, calls for a brief historical note, even though it should make two ingenious gentlemen "curse those who said our good things before us."

It is obviously true that the staff which best conforms to our chromatic scale of twelve equal steps to the octave, and best appeals to the mind accustomed to grapho, is one of 12 (13) equally spaced lines for an octave; or since it is difficult to distinguish among so many lines alternate lines may be omitted so leaving a 6-line or whole-tone scale. These facts are so obvious that both forms have been invented repeatedly, as is shown by patents long since expired. The earliest use found was by Joshua Steele in "Melody in speech," London, 1775. To distinguish between the numerous lines he superposed the ordinary five lines and used some dotted lines. For many years I have found this notation very convenient for writing non-harmonic scales or music and have referred to it occasionally in print, but it seems never to have appealed to musicians.

Modifications of this many-lined staff have been proposed; one uses only four or three lines, but any note, as C, will come in the same position in all octaves; sometimes the note-heads are of different shapes. The most frequent modification is to retain only the five lines that correspond to the black keys of the piano—a scheme closely analogous in principle to the old tablatures. This was

advocated by Busoni who published a few pages of music written on what may be called the "black key staff."

Corresponding to the whole-tone staff the very logical whole-tone keyboard has likewise been proposed by several patentees and is most notably found in the Janko keyboard; this had considerable vogue in Germany and a few were built in this country some twenty years ago; but the instruments with this keyboard are so rare that the musician could scarcely afford the time to practise on it if he had access to one.

A Question of Tuning.—One of the musical trade papers reported some months ago that a phonograph dealer in Chicago had two similar pianos tuned alike, except that in one of them one string belonging to each set of these unisons was tuned to give a slow beat with the other two. Then the public was asked which tuning it preferred; a large majority chose the one with the beat. This preference quite disconcerted the editor who reported it; "What is the use," he says, "of trying to keep a piano in tune when a mistuned one is really liked better?"

This does not seem to me to involve the question of being out of tune in the ordinary meaning of the term; if a chord is struck two thirds of the strings will sound together in the usual way, though the accuracy of tuning will be somewhat blurred or masked by the beats due to the other strings.

But a similar even more marked effect has long been obtained in other ways and has often been proposed by inventors. It is akin to the tremolo which is familiar as a means of expression on many instruments and which in vocal music may be a sign of emotion or even weakness. On the violin a tremolo may come from the rolling of the player's finger along the string, and on mechanical violins from intermittent pressure on the tail piece. Even more closely analogous to the effect in the piano experiment and long known are the results of the "Celeste" stop on the reed organ that brings into use two sets of reeds which beat slightly with one another; and in the pipe organ of the "Vox Celeste" or "Unda Maris" stop that brings on two sets of pipes which beat producing a very few waves per second.

So the Chicago experiments seem to me to indicate, not that hearers object to having the notes of the piano in tune, but that they welcome a new way of introducing variety, vitality, into piano tone. After the key is struck there comes the loud thud characteristic of the piano sound and then the gradual dying away of the sound; the musician can do nothing with the tone but let it die away till he is ready to drop the damper. The player of most other instruments has considerable control over the loudness of a continued sound and occasionally to some extent over its pitch and quality; this is obviously true of most orchestral instruments, and of the organ with its swell and the harmonium with its "expression" due to pumping.

This double control, of loudness and pitch, was realized in the old clavichord and was sought for in the "Steinertone" patented and built by the late Morris Steinert fifteen or twenty years ago. I have recently learned from the makers that in the reproductions built some years ago by Chickering & Sons under direction of Mr. Dolmetsch "the clavichord was tuned with one string of each note two or three waves sharper than the others, and on the harpsichord the second unison was slightly sharper than the first." In the electrical "Choralcelo" exhibited in Boston some years ago there was control both of loudness and quality while a note was sounding.

So the Chicago experimenters and listeners are in good company.

Of course the piano must have some great compensating advantages to lead the world to overlook so great a defect as this lack of variety, but they do not concern us now or here.

The Tuning Fork.—In a recent article in a psychological journal the tuning fork is considered as composed of two bars each attached at one end to a solid block; in a current book for piano tuners a fork is illustrated as sending off a train of waves in one direction, both prongs being bent in the same direc-

tion. These surprising disclosures led to an examination of a number of text-books, etc., on sound, from which it appeared that only rarely was there any reference to the true theory of the fork; even the Britannica supports the view of the psychologist. So a note on the subject may not be superfluous.

The theory of the fork is due to Chladni's researches of a century ago. He had found that a horizontal straight uniform bar could vibrate when supported at points about 0.22 of its length from the ends; obviously portions each side of these nodal points must at any instant be moving in opposite directions. Then he bent the bar a little and found that the nodes had moved toward the center, and when the fork-shape with long parallel prongs was reached, the nodes were near the base of the prongs. Assuming the prongs vertical, when they separated the intermediate part near the bends would of course rise a minute distance. In any practical case the center portion is loaded by the stem which will therefore move up and down and deliver regular blows to a sounding board or resonance box on which it may be placed. Such an effect can not be accounted for by the crude theory that prompted this note.

It will help to clear thinking to recall the curious fork shown by the Standard Scientific Co. at the exhibit of apparatus at the Bureau of Standards about a year ago. This had a relatively large hole near the upper end of the stem, the effect of which was to make the pitch much lower than that of a similar fork unperforated.

In this connection it may be added that measures I made some years ago showed that a Koenig's fork of the middle octave on its box, when vibrating at an average amplitude, expended its energy at the rate of about one millionth of a horse power or less than a thousandth of a watt; of course only a small part of this produces sound and only a very minute fraction of this part could reach the ear of any one of the hundred who could hear the fork.

CHARLES K. WEAD

ANN ARBOR, MICH.

SPECIAL ARTICLES

THE RELATION OF SOIL FERTILITY TO VITAMINE CONTENT OF GRAIN [1]

THIS study was undertaken at the suggestion of Professor F. J. Alway, who has made a study of the relation of phosphate-hungry peat soils to the grain produced on them,[2] at Golden Valley, Minn.

Burning of the peat rendered mineral matter more available to the plant and increased the yield. It also increased the amount of phosphoric acid in the grain and, as we shall show, increased the vitamine. Two experiments were made, one with barley grown on untreated and on burned peat, and another on oats grown on peat soil as contrasted with ordinary mineral soil. The barley grown on untreated peat yielded 7.4 bushels per acre and the grain contained 0.5 per cent. P_2O_5 in the dry matter, or 17.9 per cent. in the ash, whereas the barley grown on burned peat yielded 42.6 bushels per acre and contained 1.06 per cent. P_2O_5 in the dry matter and 35.5 per cent. in the ash. The oats grown on untreated peat soil contained 0.52 per cent. P_2O_5 in the dry matter and 17.9 per cent. in the ash. The oats grown on ordinary mineral soil in the same locality contained 1.1 per cent. P_2O_5 in the dry matter and 32.4 per cent. in the ash. It was at first attempted to determine the vitamine content of these grains by the quantity necessary to prevent or cure polyneuritis in pigeons. It was very difficult, however, to feed these grains quantitatively to these pigeons, and they all died of polyneuritis before the end of the experiment.

The next attempt was to feed the whole grains quantitatively to white rats, but this method failed also.

The next method was to grind the grains and mix them to the extent of 5 per cent. in a

1 Contribution from the laboratory of physiological chemistry, University of Minnesota Medical School.

2 F. J. Alway, "A phosphate-hungry peat soil," *Journal of the American Peat Society*, Vol. 8, 1920.

basic ration made of 10 per cent. pure casein, 6 per cent. sea salt and 84 per cent. white flour. The rats were allowed to eat this *ad libitum* and were supplied with ordinary tap water in addition. At the end of the thirty-second day butter fat was added to the ration to the extent of 1 gram per rat per day. The experiment lasted 65 days. In the above experiment, two rats, both males and weighing 65 grams each, and of the same litter, were taken and fed this diet. At the end of the 65 days the rat getting the barley with 0.5 per cent. P_2O_5 weighed 108 grams, whereas the one getting barley containing 1.06 per cent. P_2O_5 weighed 117 grams. This difference of 9 grams is small, and yet, owing to the exact manner in which the experiment was performed and the fact that the rats were of the same sex, size and litter, this small difference is significant.

In the experiment with oats two female rats of the same litter were taken. These rats were practically the same weight. In fact they were of exactly the same weight (55 grams) on the second day of the experiment. At the end of 65 days the rat receiving oats with 0.53 per cent. P_2O_5 weighed 86 grams and the rat receiving oats containing 1.1 per cent. P_2O_5 weighed 97 grams. It may be remarked that the experiments with female rats are not always quite as uniform as those with male rats, but these female rats showed no peculiarities in the growth curves. These experiments are in harmony with those of a number of workers and show that the vitamine content of *milled grains* is proportional to the content in P_2O_5. In the case of milled grains, however, the variation in P_2O_5 is due to its partial removal in milling, whereas in experiments recorded in the present paper the variation is due to the amount of available phosphoric acid in the soil. Since butter fat was fed uniformly throughout the last half of the experiment, the difference in growth of the rats is due to difference in vitamine *B*.

J. F. McClendon,
A. C. Henry
University of Minnesota

MOLD HYPHÆ IN SUGAR AND SOIL COMPARED WITH ROOT HAIRS

To compare sugar with soil as a place for growing molds may at first sight be revolutionary, but to one who has studied molds in soil, the first glimpse of a moldy sample of sugar under the microscope compels the comparison put forward in the title of this paper. Mold hyphæ as seen in foods such as sugar and in soil strikingly resemble root-hairs as they develop in earth. Hyphæ of fungi and root-hairs are analogous structures. Both belong to the vegetative phase of a plant's life cycle. Both are turgid, thin-walled cells. The elongating hypha pushes itself between sugar crystals or between soil particles in the same fashion as the elongating root-hair progresses in the soil. The elongating hypha, like the root-hair, is a feeding and growing portion of a plant, which is submerged in a substratum. The hyphal tip, as is commonly understood of the apex of a root-hair, follows between the sugar crystals or soil particles along the path offering the fewest obstacles. Such a path or course is at best winding, irregular, now wide and again extremely narrow. The mold hypha under suitable conditions grows between the faces of the sugar crystals or soil particles. As would the root-hair, it forces its way into a narrow passage, its shape conforming to the space discovered. There may be a bulge on one surface of the hypha and a flattened area on the opposite surface, all depending on the space available for expansion. Attracted by the films of water and available solutes adhering to the sugar crystal or to the soil particle, the mold hypha grows over the face of a particle, conforming to the irregularities in the surface of the object.

It is impossible to separate these bits of mold hyphæ from the respective sugar crystals or soil particles in conjunction with which they are growing. It is commonly known that a separation of soil particles from root hairs, which are much grosser units than segments of mold hyphæ, is impossible without injury to the root-hairs.

To one familiar alone with the easily studied and regular structure of a root-hair developed in a moist chamber, the root-hair as it grows in the soil is not recognizable except as it is traced to its point of attachment among the other epidermal cells of the root. Parallel to this statement it may be said that to one familiar alone with mold hyphæ as they may develop with freedom in liquid or solid culture media such as agar or gelatine, the mold hyphæ growing under natural conditions among sugar crystals or between soil particles are totally unrecognizable, neglected and passed over. No suitable bacteriological methods of making dry smears or stained preparations have yet been devised for demonstrating molds in such situations. These mold hyphæ are enough larger than minute bacteria to be plasmolyzed and for their structure to be dried out beyond recognition by this exceedingly harsh treatment. The best of objectives with high magnifications are required to demonstrate this close relation of mold hyphæ either to sugar crystals or to soil particles. For this an oil immersion objective must have a long working distance to permit a mount as thick as a sugar crystal or soil particle to be examined with the mold hyphæ attached. This has been possible with such a combination as a Zeiss 3 mm. N. A. 1.30 apochromatic objective and a 12 X compens. ocular. Few other available combinations will give the necessary clarity of field, magnification and working distance to demonstrate the intimate relationship existing between the mycelium of saprophytic molds and certain substrata.

This intimate relationship between mold hyphæ and the substratum explains why many have overlooked active growths of molds in the soil and others have denied it. It explains also in part the spoilage of certain foodstuffs such as sugar. Much damage can undoubtedly take place without macroscopic evidence of mold. Mold hyphæ have just such an intimate relationship to sugar crystals or soil particles as is well known to exist between root hairs of higher plants and the soil particles of the ground wherein they grow.

MARGARET B. CHURCH,
CHARLES THOM

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF ORGANIC CHEMISTRY

Roger Adams, chairman.
H. T. Clarke, secretary.

Oximes: F. W. ATACK.

Organo tellurium bases: A. LOWRY AND R. F. DUNBROOK. Aromatic bases and $TeBr_4$ react in ether or acetic acid solution to produce organo tellurium bases. The following complexes have been prepared and analyzed:

$(C_6H_5NH_2)_2.TeBr_4$
= Bi-aniline tellurium tetrabromide,
$[C_6H_5N(CH_3)_2]_2.TeBr_4$
= Bi-dimethylaniline tellurium tetrabromide,
$(\beta\text{-}C_{10}H_7NH_2)_2.TeBr_4$
= Bi-β-naphthylamine tellurium tetrabromide,
$p\text{-}C_6H_4(NH_2)_2.TeBr_4$
= p-phenylenediamine tellurium tetrabromide,
$m\text{-}C_7H_6(NH_2)_2.TeBr_4$
= m-toluylenediamine tellurium tetrabromide,
$(p\text{-}BrC_6H_4NH_2)_2.TeBr_4$
= Bi-p-bromoaniline tellurium tetrabromide,
$[(C_6H_5)_2NH]_2.TeBr_4$
= Bi-diphenylamine tellurium tetrabromide,
$H_2NC_6H_4.C_6H_4.NH_2.TeBr_4$
= Benzidine tellurium tetrabromide,
$[(CH_3)_2N.C_6H_4]_2CH_2.TeBr_4$
= Tetramethyl-diamino-diphenyl-methane tellurium tetrabromide.

Alkaloids also produce complexes with $TeBr_4$.

The rôle of acetic acid and ammonia as catalysts in the formation of acetamide from ammonia acetate: W. A. NOYES AND WALTHER GOEBEL. Dr. M. A. Rosanoff showed several years ago that acetamide may be prepared at atmospheric pressure by heating ammonium acetate with an excess of glacial acetic acid. He considered that the acetic acid is a catalytic agent but, as he worked under conditions such that the water formed distilled away, he did not actually prove whether the acetic acid acted as a catalyst or whether it merely retained the ammonia and made it possible to heat the mixture to a higher temperature without the loss of much ammonium acetate by dissociation. By heating ammonium acetate in sealed tubes, alone, and again with acetic acid and in other experiments with ammonia, we have shown that either acetic acid or ammonia acts as a catalyst and hastens the reaction. The liberation of ammonia by the addition of a little sodium hydroxide to the ammonium acetate, however, retards the reaction, probably because the acetate ions from the sodium acetate formed repress the ionization of the acetic acid formed by the dissociation of the ammonium acetate. These

$$CH_3COONH_4 \rightleftarrows CH_3COOH + NH_3 \rightleftarrows CH_3C(OH)(OH)NH_2 \rightleftarrows CH_3CONH_2 + H_2O$$

$$H^+ + CH_3CO_2^- \qquad H^+ + NH_2^- \qquad H^+ + OH^-$$

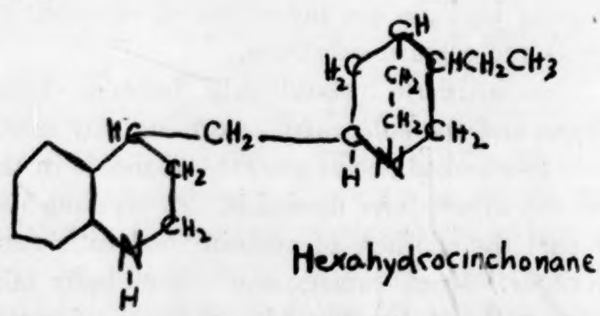
results point to the above mechanism for the reaction.

If this is accepted, it would seem that acetic acid catalyzes the reaction chiefly through its hydrogen ions and ammonia through its amide, NH_2^-, ion.

Preparation of absolute alcohol: W. A. NOYES. Beilstein contains a statement that alcohol is dehydrated commercially by means of calcium chloride but I have been able to find no other reference to the matter in the literature. A careful study has brought out the following: From strong alcohol containing somewhat more than one mol of calcium chloride for each mol of water present, alcohol of 99 per cent. or stronger may be distilled. On concentrating such a solution a solid alcoholate (not a hydrate) separates and there is an equilibrium between the alcoholate and hydrate present. A quite high temperature is required to expel the alcohol from this solid but if enough water is added so that about 5 mols are present for each mol of calcium chloride, the alcohol may be distilled away completely at a temperature below 140°. The hydrate of calcium chloride which remains is liquid at 100°, or above, but solidifies at ordinary temperatures. On the basis of the facts given, 99 per cent. alcohol may be prepared, by means of calcium chloride, without loss of alcohol. The remainder of the water can then be removed by lime or by some other method.

5, 8-diamino-dihydroquinine and 5, 8-diamino-6-methoxyquinoline, and their conversion into the corresponding amino-hydroxy and dihydroxy bases: WALTER A. JACOBS AND MICHAEL HEIDELBERGER. 5, 8-diamino-dihydroquinine, obtained by reducing 5-amino-8-*p*-sulfophenylazo-dihydroquinine (*J. Am. Chem. Soc.*, 1920, xlii, 2281); decomposes at 125–40°, and yields a vermilion, crystalline tetrahydrobromide and a brown crystalline sulfate decomposing at 220–7°. 5-hydroxy-8-phenylazo-dihydroquinine (*Ibid.*, p. 2280) yielded a crystalline double tin salt of 5-hydroxy-8-amino-dihydroquinine, the base and other salts being very unstable. Boiled with 1:1 hydrochloric acid the diamino compound yielded the dihydroxy dihydrochloride, vermilion needles decomposing at 208–11° (anhydrous), also obtained from acid solutions of the amino-hydroxy compound on long standing. For comparison the series derived from 6-methoxyquinoline was also prepared, 5, 8-diamino-6-methoxyquinoline forms golden leaflets melting at 163–4°; 5-hydroxy-8-amino-6-methoxyquinoline yellow crystals melting at 180–2°, and the 5, 8-dihydroxy compound yellow crystals melting at 195–7°. The lability of the amino groups in these compounds as well as in the previously reported dyes is thus shown to be of a high order.

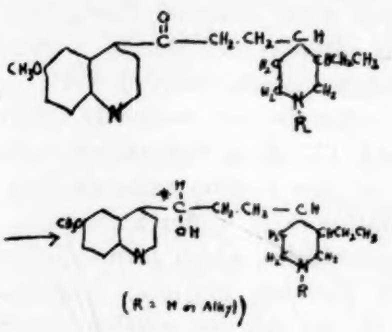
The hydrogenation of dihydrocinchonine, chinchonine, and dihydroquinine: WALTER A. JACOBS AND MICHAEL HEIDELBERGER. By reducing dihydrocinchonine with sodium in boiling amyl alcohol and converting into the hydrochlorides two stereoisomeric hexahydro bases were isolated, in which the 2ν alcoholic group had also been reduced. These α- and β-hexahydrocinchonanes (for terminology see *J. Am. Chem. Soc.*, 1920, xlii, 1492) were crystalline, and yielded characteristic hydrochlorides, nitroso, benzoyl, and phenlyazo derivatives, thus showing the properties of tetrahydroquinolines. From the mother liquors a small amount of hexahydrocinchonine dihydrobromide was isolated. The α- and β-compounds were also obtained by reducing dihydrocinchonane. Cinchonine yielded an α-tetrahydrocinchonane, convertible into the α-hexahydro compound with Pd and H, while the mother liquors also reduced with Pd and H gave the α-, β-, and hexahydrocinchonine-compounds. Dihydroquinine yielded chiefly hexahydroquinine dihydrochloride, characterized by the nitroso and benzoyl derivatives.



Hexahydrocinchonane

A new series of cinchona-like alkaloids: the dihydroquinicinols: MICHAEL HEIDELBERGER AND WALTER A. JACOBS. Reduction of the quinicines (quinotoxines) with palladium and hydrogen gives rise to a new series of alkaloids with an asymmetric secondary alcoholic group, thus resembling the cinchona alkaloids themselves. Quini-

cine hydrochloride gave *d*-dihydroquinicinol nitrate, which yielded the crystalline base and dihydrochloride. Only the *l*-dihydrochloride could be obtained. N-methylquinicine dihydrochloride gave both *d*- and *l*-N-methyl-dihydroquinicinol, which crystallized readily. The *d*-hydrobromide, dihydrochloride, and methiodide were prepared, as well as the *l*-dihydrochloride and methiodide. Similarly, N-ethylquinicine hydrochloride gave the *d*-base, from which the mono- and di-hydrochlorides and methiodide were prepared. An *l*-dihydrochloride was also isolated. Ethyldihydrocupreicine sulfate (optotoxin) gave the *d*-hydrochloride, from which the base and dihydrochloride were obtained. Methyl and ethyl iodide yielded the corresponding crystalline N-alkyl bases. *d*- and *l*-dihydrocinchonicinol sulfate were also obtained.



The action of ammonia on chlorobenzene and bromobenzene in the vapor state in presence of catalysts: A. LOWY AND A. M. HOWALD. Ammonia mixed with the vapor of a halogenated benzene compound was passed over various catalysts at elevated temperatures to determine the possibility of replacing the halogen by the NH_2 group. Iron, nickel and cobalt were the only active catalysts. The optimum temperature for iron was 480° C. and gave a yield of 7.35 per cent. of aniline. The catalysts used were rapidly poisoned. This substantiates previous experimental evidence that halogens have poisonous effects upon catalysts. Several oxides, salts, elements and alloys were also tried as catalysts.

The effect of fullers' earth on pinene and other terpenes: C. S. VENABLE AND E. C. CROCKER. An investigation has been made of the effect, under various experimental conditions, of fullers' earth on pinene and other terpenes. In the presence of fullers' earth, various terpenes react spontaneously or upon a slight elevation of temperature. In the case of pinene, the first effect is that of intermolecular rearrangement, the chief products being dipentine and terpinene. These terpenes again react in the presence of fullers' earth to give dipinene, boiling point 320° C. It is conceivable that the intermolecular rearrangement and the polymerization take place simultaneously. The local overheating of the 320° fraction in the presence of fullers' earth results in a depolymerization with a formation of paraffin hydrocarbons, *p*-cymene, etc., and the 360° fraction. The course of reaction as thus shown is entirely different from that indicated by the work of Gurvich, *J. R. P. C. S.*, 1915–16. A similar set of reactions has been observed for dipentine, terpinene, camphene, beta pinene, active limonene, sabinene and terpineol. The reaction in the case of cineol is very slow; *p*-cymene does not give a reaction.

A study in yields in nitrating nitrotoluenes: J. M. BELL AND D. M. CARROLL.

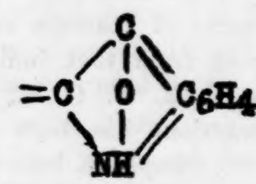
Studies on nucleic acids: The reduction of uracil and cytosine by means of colloidal platinum: TREAT B. JOHNSON AND ELMER B. BROWN. The reduction of uracil leads to a quantitative production of hydrouracil, which can be hydrolyzed quantitatively to β-alanine. Transformations can be brought about at low temperatures in the pyrimidine series by catalytic reduction which can not be accomplished by other means.

Studies on nucleic acids: New color tests for the pyrimidine-thymine, applicable in the presence of uracil, cytosine and sugars: TREAT B. JOHNSON AND OSKAR BAUDISCH. Thymine is oxidized in the presence of ferrous sulphate with formation of urea, pyruvic acid and acetol. Both pyruvic acid and acetol can be identified by characteristic color tests, which serve for the indirect identification of thymine. The reaction is of immediate service in determining the constitution of nucleic acids.

Hydantoin indigoids: ARTHUR J. HILL AND HENRY R. HENZE. (By title.) Nuclear aromatic aldehydes condense readily with the methylene (CH_2) group of hydantoin and many of its derivatives. On the contrary, however, only three aliphatic aldehydes have been directly combined with hydantoin while there is no literature bearing on the behavior of the carbonyl group of ketones toward this type of compound. The writers have been able to effect condensation between certain hydantoins, namely, 1-phenyl-2-thiohydantoin, 1-phenylhydantoin and hydantoin, and the cyclic ketone isatin, and its chloride. Two types of condensation products have thus been obtained,

namely, β-isatin derivatives from isatin itself, and α-derivatives from the α-chloride.

These new products are all highly colored, and, in their molecular configuration, resemble the dyes of the indigoid group. The color of α-derivatives, which contain the true indigoid chromophore,



as postulated by Claasz, is deeper than that of the corresponding β-homologues.

Synthesis of the soporific nirvanol (4, 4-phenyl ethyl hydantoin): William T. Read. Nirvanol (4, 4-phenyl ethyl hydantoin), a soporific now extensively used in Europe, has been made in good yield by the following method. Phenyl ethyl ketone, prepared from propionyl chloride and benzene by the Friedel and Crafts reaction, is condensed with ammonium cyanide in alcohol solution.

$$C_6H_5COC_2H_5 + NH_4CN \rightarrow C_6H_5(C_2H_5)C(CN)NH_2.$$

The resulting α-phenyl α-aminobutyronitrile, or its hydrochloride, is treated with potassium cyanate in glacial acetic acid solution, whereby phenyl ethyl hydantoic nitrile is obtained. The nitrile is readily converted into 4, 4-phenyl ethyl hydantoin by boiling with hydrochloric acid.

The synthesis of β-chlorallylchloride from α, γ-dichlorhydrin: Arthur J. Hill and Edwin J. Fischer. A practical method for preparing chlorallylchloride is not described in the chemical literature. A method has now been developed for the practical preparation of this chloride from dichlorhydrin by dehydration of the latter with phosphorus oxychloride. This chloride is of immediate interest and value

$$ClCH_2.CHOH.CH_2Cl \rightarrow ClCH:CH.CH_2Cl$$

for the synthesis of new organic combinations of therapeutic and pharmacological interest.

The action of ferrous hydroxide-peroxide on thymine, lactic acid and alanine: Oskar Baudisch. Ferrous hydroxide-peroxide acts in a double capacity as an oxidizing and a reducing agent. From a biochemical standpoint it behaves like an enzyme. As a chemical reagent it has received hitherto very limited attention, but its marked activity at ordinary temperature due to the presence of iron in its molecule stimulates a special interest in a study of its action on biochemical products.

The behavior of cystine to acid hydrolysis: Walter F. Hoffman and Ross Aiken Gortner. Many authors agree that the amino acid, cystine, is destroyed by acid hydrolysis but no decomposition products have been isolated. In the present study a large quantity of cystine was boiled with 20 per cent. hydrochloric acid for 196 hours, aliquots being removed at intervals of 3, 6, 12, 24, 48, 96, 144, and 196 hrs. Various possible chemical changes were followed throughout this period. The authors find that (1) decarboxylization and deamination proceed very slowly, (2) that the sulfur is not markedly broken off by boiling, and (3) that the major change is the alteration of the cystine molecule into an "isomeric" cystine with different crystal form and different solubilities, which forms different derivatives from ordinary cystine. Approximately 90 per cent. of the original cystine was isolated as "isomeric" cystine after boiling for 196 hrs.

A comparison of certain derivatives of "protein" cystine and the "isomeric" cystine formed by acid hydrolysis: Ross Aiken Gortner and Walter F. Hoffman. Certain derivatives of the "isomeric" cystine noted in the preceding paper were compared with the corresponding derivatives of the natural l. cystine. Protein cystine crystallizes in large hexagonal plates, the isomeric cystine in tiny microscopic prisms. The benzoyl derivative of l. cystine crystallizes in needles, m. p. 180–181°. The "isomeric" benzoyl derivative crystallizes in diamond-shaped crystals, m. p. 168°. The phenyl isocyanates melt at 148–149° and (isomeric) 181°, respectively. It was found impossible to prepare a phenyl hydantoin from the phenyl isocyanate of the isomeric cystine, whereas a phenyl hydantoin melting at 122–123° was easily prepared from the corresponding derivative of the normal l. cystine. The cysteic acids were prepared and show different properties and different crystal form. The study is being continued.

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